ABSTRACT

A foremost problem for healthcare workers is the transmission of pathogens and bacteria from their patients to themselves and the reverse contamination. Bacteria contaminated fabric in hospitals are known to be a major source of infection as any blood contamination could pose a risk of transmission of bacteria and virus. In recent times the market demand of healthcare textiles has increased incredibly and the scope of surgical gowns is enormous due to hygiene consciousness. As infectious diseases like Hepatitis, SARS have reached an alarming limit, the method of protection from these dreadful diseases need to be improved. Without usage of sufficient barriers, harmful bacteria can reach and penetrate the skin of surgeons with an associated potential for infection.

In addition, when pathogens contaminate gowns they can be transmitted to other persons beyond the initial wearer. Healthcare personnel use a protective garment called surgical gown to safeguard against virus. With growing concerns about the emergence of hazards associated with the transmission of blood-borne pathogens, the purpose of surgical gown suddenly has changed from protecting the patient from the surgeon to protecting the surgeon and paramedical staff from the patient as well. Therefore, the surgical gown should protect the blood borne infectious virus

from penetrating through the fabric and hence the current research work gains importance as the fabric should be liquid barrier.

This research work is an attempt towards developing tri-laminate antiviral surgical gown using the polypropylene, polyester and viscose nonwoven fabrics. Tri-laminate antiviral surgical gowns were developed from different nonwoven fabrics combinations using Polytetrafluroethylene (PTFE) membrane as the middle layer and studied their performance and characteristics for barrier against viruses as per the Association for the Advancement of Medical Instrumentation (AAMI).

Spunbond polypropylene, polyester and viscose nonwoven fabrics with basis weight of 25 grams per square were sourced. The nonwoven fabrics pore size was characterized to analyze their suitability. Titanium dioxide nano particles were synthesized using Titanium tetra chloride as a precursor. Synthesis were carried out at various temperature and 170º C optimized. High resolution transmission electron microscope was used for carrying out characterization of nano particles. The nano particles obtained at 170º C yielded an average diameter of 9 nm. For the application of titanium nano dispersion finishes, the most widely used method of application of the pad-dry-cure process was used. Nano finished fabrics were characterized using Scanning Electron Microscope.

First tri-laminate antiviral surgical gown named as PP 1 was developed with titanium nano finished polypropylene as an outer layer, PTFE film as a middle layer and polyester nonwoven as an inner layer which were bonded together using a fusing machine at a temperature of 210° C with heated roller temperature of 240° C and roller pressure of 120 N/cm^2. The developed surgical gown pore size was analyzed with capillary porometry. The developed tri-laminate surgical gown was tested and analyzed for the properties such as antibacterial, viral penetration analysis, tensile strength, tearing strength, spray impact penetration, hydrostatic resistance and moisture vapour transmission using standard testing procedures under standard atmospheric conditions. From the analysis of the PP 1 tri-laminate surgical gown, antibacterial reduction of 98.83% was observed and surgical gown has passed viral penetration analysis. The developed PP 1 antiviral surgical gown confirms level 4 protection as per AAMI.

The Polypropylene/PTFE/Viscose tri-laminate antiviral surgical gown named as PP 2 was also developed, combining positive attributes of the skin friendly viscose nonwoven as an inner layer with polypropylene and PTFE. The suitability of this tri-laminate fabric for antiviral surgical gown was analyzed. From the analysis it is observed that addition of viscose nonwoven as an inner layer increases the moisture vapour permeability of gown as compared to PP 1 gown. The gown has passed the viral penetration test, which confirms that the gown has protection against the hepatitis B,

hepatitis C, human Immunodeficiency viruses and surrogate ΦX174 bacteriophage. The tensile, tearing, spray impact resistance and hydrostatic resistance of PP 2 are lower as compared to PP 1.

In addition Polyester/PTFE/Viscose tri-laminate antiviral surgical gown named as PET 3 was developed by replacing polypropylene with polyester as an outer layer. The PET 3 gown has passed viral penetration analysis and has better moisture vapour permeability as compared to PP 1 and PP 2, though is lower in various mechanical properties.

The effect of plasma enhanced flurocarbon treatment on outer layer of surgical gown has been studied. The polypropylene nonwoven was treated with flurocarbon using atmospheric argon plasma. The flurocarbon treated sample finished with nano dispersion was characterized using scanning electron microscope. The flurocarbon treated gown has better antibacterial and spray impact penetration as compared to PP 1. Moisture vapour transfer rate of flurocarbon treated gown decreased by 21% in comparison with untreated gown. Dual laminated flurocarbon treated polypropylene and polyester nonwoven gown failed in viral penetration analysis. PP 1 tri-laminate antiviral surgical gown is a more suitable choice for healthcare application because of its better liquid barrier protection according to AAMI and PET 3 tri-laminate antiviral surgical gown is also most suitable for situations requiring long duration surgery for comfort characteristics.